Ecological Risk Screening Evaluation
Eagle Zinc Site, Hillsboro, Illinois
Work Assignment No. 102-RDRD-B5Y7/Contract No. EP-S5-06-01

PREPARED FOR: USEPA

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DATE: August 19, 2011

1. Introduction

An ecological risk screening evaluation was conducted as part of the remedial investigation (RI) in 2005. The ecological risk screening evaluation concluded that the ecological risks were negligible. A subsequent technical memorandum was prepared in 2005 to evaluate a future risk scenario involving disturbance of the residue piles, and an addendum to the ecological risk screening evaluation was prepared in 2006. Unacceptable risks were identified for extensive disturbance of the residue piles when a fraction was deposited over previously undisturbed areas onsite. The site is approximately 132 acres in size with about 30 acres of abandoned buildings and structures. Within the area of the buildings and along the south and southwestern portion of the site, residue is present in piles and spread across the surface.

The purpose of this memorandum is to evaluate potential ecological risks based on the additional surface water, sediment, surface soil, and residue sample data collected in November and December of 2010 as part of a Supplemental Remedial Investigation (SRI). The data further the evaluations of ecological risk that were completed as part of the RI and earlier investigations (Environ 2004a,b and 2006), which showed the presence of metals (arsenic, cadmium, copper, lead, manganese, and zinc) at concentrations indicating a potential risk to ecological receptors.

A more detailed discussion of the goals and objectives of the SRI, along with a summary of the data collected for this sample event, are presented in the Site-Specific Plans for this investigation (CH2M HILL 2010).

The remainder of this document consists of the following sections:

- Section 2—Evaluation Overview and Approach: Summarizes the data and groupings used for the evaluation and presents the approach employed to analyze the additional data.
- Section 3—Risk Results: Presents the results of the evaluation conducted with the SRI data.
- Section 4—Summary and Conclusions: Summarizes the results of the evaluation for surface water, sediment, and surface soil and draws overall conclusions about the potential for ecological risk based on these additional data.
- Section 5—References.

2. Evaluation Overview and Approach

A summary of the data evaluated in the Ecological Risk Assessment (ERA) and the approach used to group the data and estimate exposure concentrations is discussed in Section 2.1. The methods used to screen the data to characterize ecological risk are discussed in Section 2.2.

2.1 Data Evaluated and Exposure Estimate

Twenty surface water, 17 sediment (0 to 6 inches), 20 surface soil (less than 2 feet), and 10 surface residue (less than 2 feet) samples collected during the SRI were evaluated. Table 2-1 summarizes the samples. The locations of the samples are shown in Figure 1 (surface soil and residue) and in Figure 2 (surface water and sediment). Surface soil and residue samples were analyzed for site-specific metals; sediment samples were analyzed for site-specific metals, acid volatile sulfide (AVS), soluble extractable metals (SEM), total organic carbon, and grain size; and surface water samples were analyzed for total and dissolved site-specific metals, pH, and hardness. The Site-Specific Plans discuss the specific objectives of the samples collected during the SRI (CH2M HILL 2010).

Table 2-1 summarizes the data groupings used for this ERA evaluation. Surface water and sediment data were separated into eastern and western groupings based on watershed drainage patterns. Surface soil data were placed into a single grouping for analysis. Surface residue data were placed into a separate grouping for analysis.

The following guidelines were used in this ERA to estimate the potential direct exposure of ecological receptors to chemicals in the sampled media:

- For each data group, the maximum detected chemical concentrations in surface water (total and dissolved), sediment, surface soil, and surface residue were used to conservatively estimate potential direct chemical exposures.
- For chemicals not detected in any samples in a medium/data grouping, the maximum method reporting limit (MRL) was used as the maximum detected chemical concentration to estimate potential direct exposure.
- For samples with duplicate analyses, the higher of the two detected concentrations was used if both values were detected. In cases where one result was a detected concentration and the other a nondetected concentration, the detected value was used in screening.

A summary of chemical concentrations is presented in Table 2-2 for eastern drainage surface water, Table 2-3 for western drainage surface water, Table 2-4 for eastern drainage sediment, Table 2-5 for western drainage sediment, Table 2-6 for surface soil, and Table 2-7 for surface residue.

2.2 Risk Screening

The following sections detail the approach used to evaluate risk with the additional data collected as part of the SRI. Section 2.2.1 describes the process used to screen the potential for ecological risk in each sampled medium/data grouping. Section 2.2.2 describes the

process used to evaluate SEM/AVS ratios to characterize the bioavailability (and potential toxicity) of selected metals in sediment. Section 2.2.3 describes the process used to compare the surface water, sediment, soils, and residue data to the concentrations of chemicals detected in potentially site-impacted areas during past sample events to determine if the chemical concentrations detected (and risks indicated) by the SRI data exceed those indicated during previous sample events.

2.2.1 Comparison to Ecological Screening Levels

Maximum chemical concentrations for surface water, sediment, surface soil, and surface residue were compared to medium-specific ecological screening levels (ESLs) to determine if there is a potential for adverse effects to ecological receptors. Consistent with the approach used in the earlier ERA evaluations (Environ 2004a, b and 2006), maximum detected chemical concentrations were used to screen the SRI data for the potential for adverse effects to ecological receptors. The medium-specific ESLs were established in the Uniform Federal Policy Quality Assurance Project Plan (CH2M HILL 2010) and identify chemical concentrations that are protective of potential ecological receptors from direct exposure in surface water (water-column-dwelling aquatic life), sediment (benthic-dwelling aquatic life), surface soil (terrestrial plants and soil invertebrates), and surface residue (terrestrial plants and soil invertebrates).

Chemicals of potential concern (COPCs) are selected using the hazard quotient (HQ) method. HQs were calculated by dividing the maximum detected chemical concentration (or MRLs for nondetected compounds) within each medium/data grouping by the corresponding medium-specific screening values. Chemicals were identified as COPCs if they were detected at concentrations exceeding the screening values (HQ greater than 1) or if they were detected but lacked screening values. Chemicals that were not detected, but that had MRLs exceeding screening values were also identified and further discussed as an uncertainty in the ERA.

HQs exceeding 1 indicate the potential for unacceptable risk since the chemical exposure concentration exceeds a toxic threshold represented by the screening value. However, screening values and exposure estimates were derived using intentionally conservative assumptions such that HQs greater than 1 do not necessarily indicate risks are present or impacts are occurring. HQs greater than 1 instead identify chemical-pathway-receptor combinations potentially representing risk and requiring further consideration. Following the same reasoning, HQs equal to or less than 1 indicate that risks are very unlikely, enabling a conclusion of no unacceptable risk to be reached with a high level of confidence and negating the need for further evaluation of that chemical-pathway-receptor combination.

2.2.2 SEM/AVS Sediment Evaluation

SEM and AVS concentrations were analyzed with a split of each sediment sample collected during the SRI. The SEM/AVS ratio is used to characterize the bioavailability of key metals in sediment, and is based on the observation that the toxicity of some metals in sediment (cadmium, copper, lead, mercury nickel, silver, and zinc) is influenced by the presence of sulfides (Suter 1993; Ankley 1996), which is the result of complexes formed between these metals and sulfides, which reduce the bioavailability and toxicity of the metals in sediment. The bioavailability of the metals is expressed as a ratio of the SEM to AVS concentrations measured

in sediment (on a molar basis). When SEM concentrations are less than the sulfide concentration (SEM/AVS ratio less than 1), toxicity to benthic-dwelling aquatic life has not been observed for these metals (Hansen and Berry 1996, Ankley 1996). A ratio equal to or greater than 1 indicates that some of the metals may be bioavailable, and if present in high enough concentrations, could have the potential to adversely affect benthic-dwelling aquatic life.

2.2.3 Comparison to Previously Detected Concentrations

The range of chemical concentrations detected in surface water, sediment, and surface soils were compared to the maximum concentrations of those chemicals detected in corresponding, potentially site-impacted media during historic sample events. The object of the evaluation is to determine if chemical concentrations detected (and risk indicated) in the sampled media exceed those observed during previous sample events. To conduct the evaluation, the maximum concentrations of chemicals detected in each medium/data grouping during the SRI were divided by the maximum concentrations of those chemicals detected during previous sample events. Values greater than 1 indicate that concentrations detected during the SRI exceed those previously detected within these media, while values less than or equal to 1 indicate that concentrations detected during the SRI are similar to or less than those previously detected within these media. Surface residue data were not evaluated in this comparison because these media represent materials directly disposed of during historic site activities, and not native materials (surface water, sediment, or surface soils) that may have been impacted by historic site activities.

3. Risk Results

The risk results present the outcome of the risk calculations described in Section 2. Section 3.1 presents the results of the comparison of maximum concentrations detected within a medium to the corresponding ESLs to derive screening risk estimates and identify a list of COPCs. Section 3.2 presents the SEM/AVS ratios that were calculated to characterize the bioavailability of selected metals in sediments. Section 3.3 presents the results of the comparison of maximum concentrations detected in media during the SRI to historic concentrations to determine if the detected analyte concentrations fall within the range of those previously detected.

3.1 Comparison to ESLs

In this section, the maximum detected chemical concentrations for each data grouping are compared to the corresponding screening values to derive screening risk estimates. The outcome of this step is a list of COPCs for each medium/data grouping evaluated or the elimination of chemicals from further consideration based on the conclusion that they are unlikely to adversely affect ecological receptors of concern.

The COPCs for each medium and data grouping are summarized in the following subsections. Results of the comparisons are presented in Section 3.1.1 for surface water (eastern and western drainage), Section 3.1.2 for sediment (eastern and western drainage), Section 3.1.3 for surface soil, and Section 3.1.4 for surface residue.

3.1.1 Surface Water

Eastern Drainage

A summary of the comparison of maximum detected metals concentrations to ESLs for eastern drainage surface water is presented in Table 2-2 and summarized below for total and dissolved metals concentrations.

- Total Metals
  - Five of six analyzed metals (cadmium, copper, lead, manganese, and zinc) were detected at concentrations greater than their ESLs and were identified as COPCs.
  - Arsenic was not detected in surface water. The MRL for arsenic remained below its ESL, and arsenic was not identified as a COPC.
- Dissolved Metals
  - Four of six analyzed metals (cadmium, copper, manganese, and zinc) were detected at concentrations greater than their ESLs and were identified as COPCs.
  - Lead was not detected in surface water. However, the MRL for lead exceeded its ESL, and lead was identified as a COPC.
  - Arsenic was not detected in surface water. The MRL for arsenic remained below its ESL, and arsenic was not identified as a COPC.

Western Drainage

A summary of the comparison of maximum detected metals concentrations to ESLs for the western drainage surface water is presented in Table 2-3 and summarized below for total and dissolved metals concentrations.

- Total Metals
  - Five of six analyzed metals (cadmium, copper, lead, manganese, and zinc) were detected at maximum concentrations exceeding their ESLs and were identified as COPCs.
  - Arsenic was not detected in surface water. The MRL for arsenic remained below its ESL, and arsenic was not identified as a COPC.
- Dissolved Metals
  - Five of six analyzed metals (cadmium, copper, lead, manganese, and zinc) were detected at maximum concentrations exceeding their ESLs and were identified as COPCs.
  - Arsenic was not detected in surface water. The MRL remained below its ESL, and arsenic was not identified as a COPC.

3.1.2 Sediment

Eastern Drainage

A summary of the comparison of maximum detected metals concentrations to ESLs for the eastern drainage sediment is presented in Table 2-4. All six analyzed metals (arsenic, cadmium, copper, lead, manganese, and zinc) were detected at maximum concentrations exceeding their ESLs and were identified as COPCs.

Western Drainage

A summary of the comparison of maximum detected metals concentrations to ESLs for the western drainage sediment is presented in Table 2-5. All six analyzed metals (arsenic, cadmium, copper, lead, manganese, and zinc) were detected at maximum concentrations exceeding their ESLs and were identified as COPCs.

3.1.3 Surface Soil

A summary of the comparison of maximum detected metals concentrations to ESLs for surface soil is presented in Table 2-6. Five of six analyzed metals (cadmium, copper, lead, manganese, and zinc) were detected at concentrations exceeding their ESLs and were identified as COPCs.

3.1.4 Surface Residue

A summary of the comparison of maximum detected metals concentrations to ESLs for surface soil is presented in Table 2-7. All six analyzed metals (arsenic, cadmium, copper, lead, manganese, and zinc) were detected at concentrations exceeding their ESLs and were identified as COPCs. It should be noted, the maximum concentrations of chemicals detected in surface residue consistently exceed those detected in surface soil (Table 2-6).

3.2 SEM/AVS Sediment Evaluation

In this section, SEM/AVS ratios are presented for each sediment sample location in the eastern and western drainages. The comparisons characterize the bioavailability of key metals (cadmium, copper, lead, mercury, nickel, silver, and zinc) and indicate whether these metals are bound to sulfide and not bioavialable (SEM/AVS ratio less than 1) or are potentially bioavailable (SEM/AVS ratio greater than 1), and have the potential to adversely affect benthic-dwelling aquatic life if present at high enough concentrations.

3.2.1 Eastern Drainage

A summary of the SEM/AVS ratios for each sediment sample collected from the eastern drainage is presented in Table 3-1. SEM/AVS ratios for all nine of the sample locations exceeded one indicating that some proportion of the metals in sediment are bioavailable and could adversely affect benthic-dwelling aquatic life if present at high enough concentrations.

3.2.2 Western Drainage

A summary of the SEM/AVS ratios for each sediment sample collected from the western drainage is presented in Table 3-2. SEM/AVS ratios for all eight of the sample locations exceeded one indicating that some proportion of the metals in sediment are bioavailable and could adversely affect benthic-dwelling aquatic life if present at high enough concentrations.

3.3 Comparison to Previously Detected Concentrations

In this section, maximum exposure concentrations detected in each medium during the SRI are compared to historic maximum detected concentrations reported in the RI (Environ 2004a). The comparison was done to determine if the concentrations of chemicals detected during the SRI are similar to or exceed those detected during the previous sampling events, the objective of which is to determine if the detected analyte concentrations (and risks) fall within the range of those previously indicated for these media.

The comparisons for each medium and data grouping are summarized in the following subsections. Results of the comparisons are presented in Section 3.3.1 for surface water (eastern and western drainage), Section 3.3.2 for sediment (eastern and western drainage), and Section 3.3.3 for surface soil.

3.3.1 Surface Water

Eastern Drainage

A summary of the comparison of maximum detected metals concentrations to historic maximum detected concentrations for the eastern drainage surface water is presented in Table 3-3 and summarized below for total metals concentrations.

- Two of six analyzed metals (lead and manganese) were detected at concentrations exceeding historic maximum detected concentrations.
- Arsenic was not detected in surface water, although the MRL for this chemical exceeded its historic maximum detected concentration.

Western Drainage

A summary of the comparison of maximum detected metals concentrations to historic maximum detected concentrations for the western drainage surface water is presented in Table 3-4 and summarized below for total metals concentrations.

- Two of six analyzed metals (copper and lead) were detected at concentrations exceeding historic maximum detected concentrations.
- Arsenic was not detected in surface water, although the MRL for this chemical exceeded its historic maximum detected concentration.

3.3.2 Sediment

Eastern Drainage

A summary of the comparison of maximum detected metals concentrations to historic maximum detected concentrations for the eastern drainage sediment is presented in Table 3-5 and summarized below.

- Three of six analyzed metals (copper, manganese, and zinc) were detected at concentrations exceeding historic maximum detected concentrations.
- Three of six analyzed metals (arsenic, cadmium, and lead) were detected at concentrations that did not exceed historic maximum detected concentrations.

Western Drainage

A summary of the comparison of maximum detected metals concentrations to historic maximum detected concentrations for the western drainage sediment is presented in Table 3-6 and summarized below.

- Manganese was the only metal detected at a concentration exceeding its historic maximum detected concentration.
- All other analyzed metals (arsenic, cadmium, copper, lead, and zinc) were detected at concentrations that did not exceed historic maximum detected concentrations.

3.3.3 Surface Soil

A summary of the comparison of maximum detected metals concentrations to historic maximum detected concentrations for surface soil is presented in Table 3-7. Three of the six metals (copper, manganese, and zinc) were detected at concentrations exceeding their historic maximum detected concentrations.

4. Summary and Conclusions

The following sections summarize the results of the continued ERA evaluation for surface water, sediment, surface soil, and surface residue based on the evaluation of data collected during the SRI.

4.1 Surface Water

- There is a potential for adverse effects to aquatic life from direct exposure to multiple metals in surface water. Cadmium, copper, lead (total concentration only in eastern drainage), manganese, and zinc were detected at concentrations exceeding ESLs in both the eastern and western drainages.
- The following metals with concentrations exceeding ESLs were also detected in SRI samples at concentrations exceeding those detected during historic sample events:
  - **Eastern Drainage**—Lead and manganese concentrations detected during the SRI exceeded those detected during historic sample events. However, lead and manganese concentrations exceeded historic maximum detected concentrations in only one and two of eight SRI samples, respectively.
  - **Western Drainage**—Copper and lead concentrations detected during the SRI exceeded those detected during historic sample events in approximately half of the SRI samples.

4.2 Sediment

- There is a potential for adverse effects to benthic-dwelling aquatic life from direct exposure to multiple metals in sediment including arsenic, cadmium, copper, lead, manganese, and zinc.

- SEM/AVS measurements suggest metals are bioavailable in sediment and have potential to be toxic at locations where they are present at elevated concentrations.
- The following metals with concentrations exceeding ESLs were also detected in SRI samples at concentrations exceeding those detected during historic sample events:
  - **Eastern Drainage**—Copper, manganese, and zinc concentrations detected during the SRI exceeded those detected during historic sample events. However, the concentrations of the metals exceeded historic maximum detected concentrations in only one to two of the nine SRI samples.
  - **Western Drainage**—Concentrations of manganese exceeded the historic maximum detected concentration in only one of eight SRI samples, indicating only a minimal frequency of exceedance.

4.3 Soil

- There is a potential for adverse effects to terrestrial life from direct exposure to multiple metals in surface soil including cadmium, copper, lead, manganese, and zinc.
- Some metals with concentrations exceeding ESLs were also detected in SRI samples at concentrations exceeding those detected during historic sample events. The metals consisted of copper, manganese, and zinc. However, the concentrations of these metals exceeded the historic maximum detected concentrations in only one or two of the twenty SRI samples, indicating only a minimal frequency of exceedance.

4.4 Residue

- There is the potential for adverse effects to terrestrial life from direct exposure to multiple metals in onsite residue including arsenic, cadmium, copper, lead, manganese, and zinc.
- Concentrations of the metals detected in residue consistently exceeded those detected in surface soil.

A summary of the above results for all media is presented in Table 3-8. The following conclusions were made about the potential for ecological risk based on an evaluation of the SRI data:

- There is a potential for adverse effects to aquatic life in both the eastern and western drainages based on the presence of metals in surface water and sediment. However, the majority of SRI surface water and sediment samples had concentrations lower than those previously detected.
- There is a potential for adverse effects to terrestrial life from the presence of metals in surface soil. However, consistent with the trend observed for surface water and sediment, the majority of the SRI surface soil samples had concentrations lower than those previously detected.

- There is a potential for adverse effects to terrestrial life from the presence of metals in surface residue. Concentrations of these chemicals in surface residue are consistently higher than detected in surface soil.

5. References

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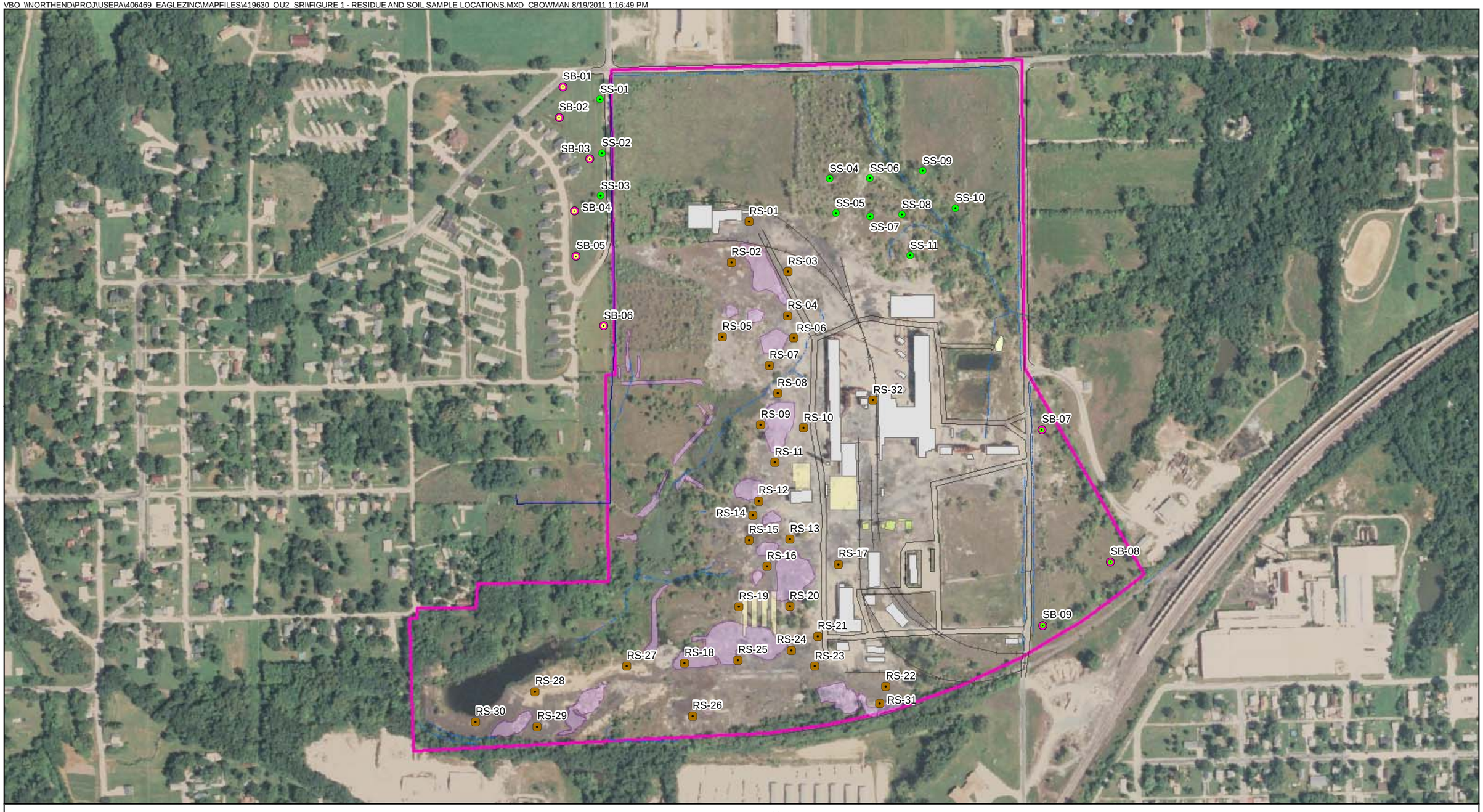
Figures

VBO \\NORTHEND\PROJ\USEPA\406469_EAGLEZINC\MAPFILES\419630_OU2_SRI\FIGURE 1 - RESIDUE AND SOIL SAMPLE LOCATIONS.MXD CBOWMAN 8/19/2011 1:16:49 PM



Legend

- Residential Soil Boring
- Residue/Soil Boring
- Soil Boring
- Surface Soil
- Fence
- Ditch
- Railroad
- Site Boundary
- Tank
- Foundation
- Building
- Residue Pile
- Rip Rap
- Culvert

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Figure 1
Residue and Soil Sample Locations
OU2 Supplemental Remedial Investigation
Eagle Zinc Superfund Site - Hillsboro, Illinois

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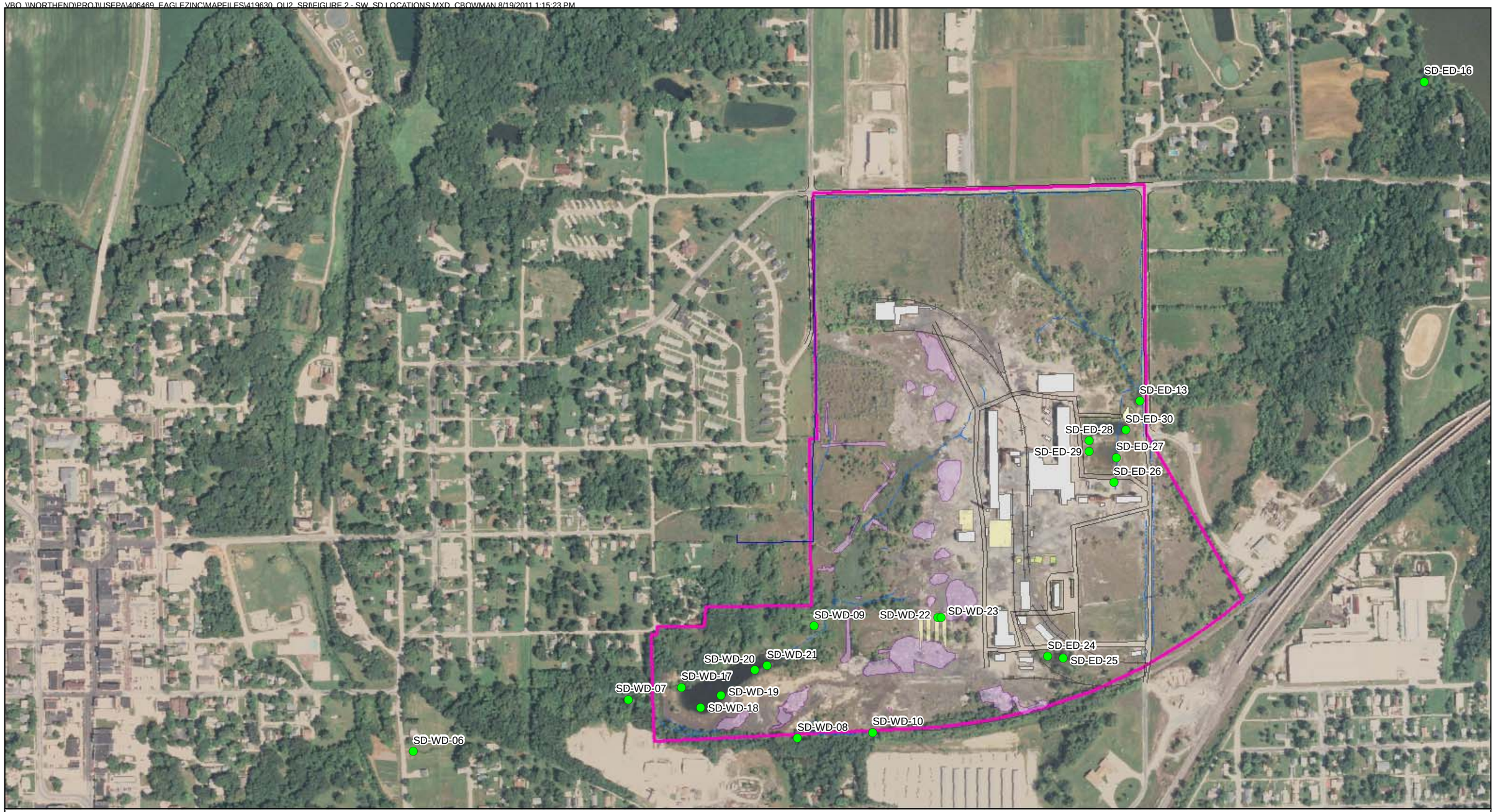
V:\0_\\NORTHEND\PROJ\USEPA\406469_EAGLEZINC\MAPFILES\419630_OU2_SR\FIGURE 2 - SW_SD LOCATIONS.MXD CBOWMAN 8/19/2011 1:15:23 PM



Legend

- Surface Water and Sediment Location
- Fence
- Ditch
- Railroad
- Site Boundary
- Tank
- Foundation
- Building
- Residue Pile
- Rip Rap
- Culvert

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Figure 2
Surface Water and Sediment Sample Locations
OU2 Supplemental Remedial Investigation
Eagle Zinc Superfund Site - Hillsboro, Illinois

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Tables

TABLE 2-1
Summary of Data Quantitatively Used in ERA
Eagle Zinc Company Site, Hillsboro, Illinois

Media/Grouping	Station ID	Sample ID	Sample Date
Surface Water			
Eastern Drainage[a]	EZ-SD-ED-13	EZ-SD-ED-13-1	12/1/2010
	EZ-SD-ED-16	EZ-SD-ED-16-1	12/4/2010
	EZ-SD-ED-24	EZ-SD-ED-24-1	12/3/2010
	EZ-SD-ED-25	EZ-SD-ED-25-1	12/3/2010
	EZ-SD-ED-26	EZ-SD-ED-26-1	12/4/2010
	EZ-SD-ED-27	EZ-SD-ED-27-1	12/5/2010
	EZ-SD-ED-28	EZ-SD-ED-28-1	12/5/2010
	EZ-SD-ED-29	EZ-SD-ED-29-1	12/5/2010
Western Drainage	EZ-SD-WD-06	EZ-SD-WD-06-1	12/2/2010
	EZ-SD-WD-07	EZ-SD-WD-07-1	12/2/2010
	EZ-SD-WD-08	EZ-SD-WD-08-1	12/1/2010
	EZ-SD-WD-09	EZ-SD-WD-09-1	12/2/2010
	EZ-SD-WD-10	EZ-SD-WD-10-1	12/2/2010
	EZ-SD-WD-17	EZ-SD-WD-17-1	12/4/2010
	EZ-SD-WD-18	EZ-SD-WD-18-1	12/7/2010
	EZ-SD-WD-19	EZ-SD-WD-19-1	12/7/2010
	EZ-SD-WD-20	EZ-SD-WD-20-1	12/7/2010
	EZ-SD-WD-21	EZ-SD-WD-21-1	12/7/2010
	EZ-SD-WD-22	EZ-SD-WD-22-1	12/3/2010
	EZ-SD-WD-23	EZ-SD-WD-23-1	12/3/2010
Sediment			
Eastern Drainage	EZ-SD-ED-13	EZ-SD-ED-13-2	12/1/2010
	EZ-SD-ED-16	EZ-SD-ED-16-2	12/4/2010
	EZ-SD-ED-24	EZ-SD-ED-24-2	12/3/2010
	EZ-SD-ED-25	EZ-SD-ED-25-2	12/3/2010
	EZ-SD-ED-26	EZ-SD-ED-26-2	12/4/2010
	EZ-SD-ED-27	EZ-SD-ED-27-2	12/5/2010
	EZ-SD-ED-28	EZ-SD-ED-28-2	12/5/2010
	EZ-SD-ED-29	EZ-SD-ED-29-2	12/5/2010
	EZ-SD-ED-30	EZ-SD-ED-30-2	12/6/2010
Western Drainage[b]	EZ-SD-WD-06	EZ-SD-WD-06-2	12/2/2010
	EZ-SD-WD-07	EZ-SD-WD-07-2	12/2/2010
	EZ-SD-WD-08	EZ-SD-WD-08-2	12/1/2010
	EZ-SD-WD-09	EZ-SD-WD-09-2	12/2/2010
	EZ-SD-WD-10	EZ-SD-WD-10-2	12/2/2010
	EZ-SD-WD-17	EZ-SD-WD-17-2	12/4/2010
	EZ-SD-WD-20	EZ-SD-WD-20-2	12/7/2010
	EZ-SD-WD-21	EZ-SD-WD-21-2	12/7/2010

TABLE 2-1
Summary of Data Quantitatively Used in ERA
Eagle Zinc Company Site, Hillsboro, Illinois

Media/Grouping	Station ID	Sample ID	Sample Date
Surface Soil[c]			
	EZ-SS01	EZ-SS01-1	11/22/2010
	EZ-SS02	EZ-SS02-1	11/22/2010
	EZ-SS03	EZ-SS03-1	11/22/2010
	EZ-SS04	EZ-SS04-1	11/18/2010
	EZ-SS05	EZ-SS05-1	11/18/2010
	EZ-SS06	EZ-SS06-1	11/18/2010
	EZ-SS07	EZ-SS07-1	11/18/2010
	EZ-SS08	EZ-SS08-1	11/18/2010
	EZ-SS09	EZ-SS09-1	11/18/2010
	EZ-SS10	EZ-SS10-1	11/18/2010
	EZ-SS11	EZ-SS11-1	11/18/2010
	EZ-SB01	EZ-SB01-1	11/29/2010
	EZ-SB02	EZ-SB02-1	11/30/2010
	EZ-SB03	EZ-SB03-1	11/30/2010
	EZ-SB04	EZ-SB04-1	11/30/2010
	EZ-SB05	EZ-SB05-1	11/30/2010
	EZ-SB06	EZ-SB06-1	11/30/2010
	EZ-SB07	EZ-SB07-1	11/29/2010
	EZ-SB08	EZ-SB08-1	11/29/2010
	EZ-SB09	EZ-SB09-1	11/29/2010
Residue			
	EZ-RS01	EZ-RS01-1	11/30/2010
	EZ-RS04	EZ-RS04-1	12/1/2010
	EZ-RS05	EZ-RS05-1	12/1/2010
	EZ-RS09	EZ-RS09-1	12/1/2010
	EZ-RS12	EZ-RS12-1	12/1/2010
	EZ-RS16	EZ-RS16-1	12/1/2010
	EZ-RS22	EZ-RS22-1	12/1/2010
	EZ-RS25	EZ-RS25-1	12/2/2010
	EZ-RS29	EZ-RS29-1	12/3/2010
	EZ-RS30	EZ-RS30-1	12/3/2010

[a] Surface water was not present and could not be collected from sample station EZ-SD-ED-30.

[b] Sediment was not present and could not be collected from the following stations in the Western Drainage: EZ-SD-WD-18, EZ-SD-WD-19, EZ-SD-WD-22, and EZ-SD-WD-23.

[c] Only the shallow fraction (0 - 2 feet) of the subsurface soil (SB) samples were evaluated in the ERA.

TABLE 2-2

Surface Water - Comparison to Ecological Screening Levels - Eastern Drainage

Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[a]	COPC?
Total Metals (µg/L)								
Arsenic	10.0 - 10.0	0 / 8	--	--	148	-- / --	0.068	NO
Cadmium	5.00 - 5.00	5 / 8	8.20	EZ-SD-ED-26-1	0.15	5 / 8	54.7	YES
Copper	25.0 - 25.0	1 / 8	4.00	EZ-SD-ED-13-1	1.58	1 / 8	2.53	YES
Lead	10.0 - 10.0	1 / 8	26.3	EZ-SD-ED-26-1	1.17	1 / 8	22.5	YES
Manganese	15.0 - 15.0	5 / 8	1,130	EZ-SD-ED-16-1	120	2 / 8	9.42	YES
Zinc	-- - --	8 / 8	4,850	EZ-SD-ED-26-1	65.7	8 / 8	73.8	YES
Dissolved Metals (µg/L)								
Arsenic	10.0 - 10.0	0 / 8	--	--	148	-- / --	0.068	NO
Cadmium	5.00 - 5.00	5 / 8	7.60	EZ-SD-ED-26-1	0.15	5 / 8	50.7	YES
Copper	25.0 - 25.0	1 / 8	3.60	EZ-SD-ED-13-1	1.58	1 / 8	2.28	YES
Lead	10.0 - 10.0	0 / 8	--	--	1.17	-- / --	8.55	YES
Manganese	15.0 - 15.0	5 / 8	1,090	EZ-SD-ED-13-1	120	2 / 8	9.08	YES
Zinc	-- - --	8 / 8	4,600	EZ-SD-ED-26-1	65.7	8 / 8	70.0	YES

[a] Shaded cells indicate hazard quotient based on reporting limits.

TABLE 2-3

Surface Water—Comparison to Ecological Screening Levels—Western Drainage

Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[a]	COPC?
Total Metals (µg/L)								
Arsenic	10.0 - 10.0	0 / 12	--	--	148	-- / --	0.068	NO
Cadmium	-- - --	12 / 12	117	EZ-SD-WD-22-1	0.15	12 / 12	780	YES
Copper	25.0 - 25.0	10 / 12	33.0	EZ-SD-WD-23-1	1.58	10 / 12	20.9	YES
Lead	10.0 - 10.0	8 / 12	40.1	EZ-SD-WD-10-1	1.17	8 / 12	34.3	YES
Manganese	-- - --	12 / 12	533	EZ-SD-WD-22-1	120	10 / 12	4.44	YES
Zinc	-- - --	12 / 12	8,660	EZ-SD-WD-10-1	65.7	12 / 12	132	YES
Dissolved Metals (µg/L)								
Arsenic	10.0 - 10.0	0 / 12	--	--	148	-- / --	0.068	NO
Cadmium	-- - --	12 / 12	112	EZ-SD-WD-22-1	0.15	12 / 12	747	YES
Copper	25.0 - 25.0	4 / 12	9.40	EZ-SD-WD-22-1	1.58	4 / 12	5.95	YES
Lead	10.0 - 10.0	2 / 12	5.10	EZ-SD-WD-22-1	1.17	2 / 12	4.36	YES
Manganese	-- - --	12 / 12	519	EZ-SD-WD-22-1	120	8 / 12	4.33	YES
Zinc	-- - --	12 / 12	8,140	EZ-SD-WD-10-1	65.7	12 / 12	124	YES

[a] Shaded cells indicate hazard quotient based on reporting limits

TABLE 2-4

Sediment—Comparison to Ecological Screening Levels—Eastern Drainage

Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	COPC?
Metals (mg/kg)								
Arsenic	-- - --	9 / 9	14.7	EZ-SD-ED-26-2	9.79	3 / 9	1.50	YES
Cadmium	0.55 - 0.55	8 / 9	57.8	EZ-SD-ED-25-2	0.99	7 / 9	58.4	YES
Copper	-- - --	9 / 9	1,090	EZ-SD-ED-26-2	31.6	5 / 9	34.5	YES
Lead	-- - --	9 / 9	917	EZ-SD-ED-26-2	35.8	7 / 9	25.6	YES
Manganese	-- - --	9 / 9	937	EZ-SD-ED-26-2	460	3 / 9	2.04	YES
Zinc	-- - --	9 / 9	276,000	EZ-SD-ED-26-2	121	9 / 9	2,281	YES

TABLE 2-5

Sediment—Comparison to Ecological Screening Levels—Western Drainage

Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	COPC?
Metals (mg/kg)								
Arsenic	-- - --	8 / 8	17.0	EZ-SD-WD-08-2	9.79	3 / 8	1.74	YES
Cadmium	-- - --	8 / 8	34.7	EZ-SD-WD-17-2	0.99	8 / 8	35.1	YES
Copper	-- - --	8 / 8	186	EZ-SD-WD-20-2	31.6	6 / 8	5.89	YES
Lead	-- - --	8 / 8	1,070	EZ-SD-WD-17-2	35.8	8 / 8	29.9	YES
Manganese	-- - --	8 / 8	1,530	EZ-SD-WD-08-2	460	2 / 8	3.33	YES
Zinc	-- - --	8 / 8	9,970	EZ-SD-WD-17-2	121	8 / 8	82.4	YES

TABLE 2-6

Surface Soil—Comparison to Ecological Screening Levels

Eagle Zinc Company Site, Hillsboro, Illinois

AnalyteName	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	COPC?
Inorganics (mg/kg)								
Arsenic	-- - --	19 / 19	17.8	EZ-SS03-1	18.0	0 / 19	0.99	NO
Cadmium	-- - --	20 / 20	9.20	EZ-SS11-1	0.36	20 / 20	25.6	YES
Copper	-- - --	20 / 20	607	EZ-SS11-1	28.0	5 / 20	21.7	YES
Lead	-- - --	13 / 13	594	EZ-SS11-1	11.0	13 / 13	54.0	YES
Manganese	-- - --	20 / 20	2,490	EZ-SB02-1	220	18 / 20	11.3	YES
Zinc	-- - --	20 / 20	26,400	EZ-SS11-1	6.62	20 / 20	3,988	YES

TABLE 2-7

Residue—Comparison to Ecological Screening Levels

Eagle Zinc Company Site, Hillsboro, Illinois

AnalyteName	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient	COPC?
Inorganics (mg/kg)								
Arsenic	-- - --	10 / 10	28.5	EZ-RS01-1	18.0	1 / 10	1.58	YES
Cadmium	-- - --	10 / 10	167	EZ-RS09-1	0.36	10 / 10	464	YES
Copper	-- - --	10 / 10	2,540	EZ-RS05-1	28.0	10 / 10	90.7	YES
Lead	-- - --	10 / 10	5,030	EZ-RS29-1	11.0	10 / 10	457	YES
Manganese	-- - --	10 / 10	19,100	EZ-RS12-1	220	7 / 10	86.8	YES
Zinc	-- - --	10 / 10	296,000	EZ-RS16-1	6.62	10 / 10	44,713	YES

TABLE 3-1
Sediment—SEM/AVS Metals Concentration Ratios - Eastern Drainage
Eagle Zinc Company Site, Hillsboro, Illinois

		Soluble Extractable Metals (UMOL/G)								Acid Volatile Sulfide	SEM/AVS
Sample ID	Sample Date	Cadmium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Total	(UMOL/G)	Ratio
EZ-SD-ED-13-2	12/1/2010	0.00	0.05	0.07	0.01	0.02	0.00	4.59	4.74	2.46	1.92
EZ-SD-ED-16-2	12/4/2010	0.00	0.06	0.03	0.01	0.03	0.00	0.67	0.80	0.05	15.08
EZ-SD-ED-24-2	12/3/2010	0.15	1.26	1.06	0.01	0.31	0.00	412.97	415.75	3.43	121.17
EZ-SD-ED-25-2	12/3/2010	0.51	0.30	0.53	0.01	0.05	0.00	42.83	44.22	7.17	6.16
EZ-SD-ED-26-2	12/4/2010	0.27	0.07	1.79	0.01	2.55	0.00	3517.90	3522.58	7.17	491.02
EZ-SD-ED-27-2	12/5/2010	0.03	0.80	0.37	0.01	0.43	0.00	290.61	292.25	43.67	6.69
EZ-SD-ED-28-2	12/5/2010	0.01	0.07	0.06	0.01	0.04	0.00	22.94	23.12	3.03	7.64
EZ-SD-ED-29-2	12/5/2010	0.00	0.04	0.04	0.01	0.02	0.00	4.28	4.39	2.78	1.58
EZ-SD-ED-30-2	12/6/2010	0.01	0.14	0.09	0.01	0.06	0.00	22.94	23.25	0.97	24.05

TABLE 3-2
Sediment—SEM/AVS Metals Concentration Ratios—Western Drainage
Eagle Zinc Company Site, Hillsboro, Illinois

		Soluble Extractable Metals (UMOL/G)									
Sample ID	Sample Date	Cadmium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Total	Acid volatile sulfide (UMOL/G)	SEM/AVS Ratio
EZ-SD-WD-06-2	12/2/2010	0.34	0.71	1.69	0.01	0.20	0.00	229.43	232.37	90.46	2.57
EZ-SD-WD-07-2	12/2/2010	0.09	0.08	0.19	0.01	0.05	0.00	48.94	49.36	1.62	30.44
EZ-SD-WD-08-2	12/1/2010	0.07	0.44	1.35	0.01	0.06	0.00	45.89	47.81	6.86	6.97
EZ-SD-WD-09-2	12/2/2010	0.06	0.17	0.87	0.01	0.02	0.00	9.64	10.76	0.13	84.14
EZ-SD-WD-10-2	12/2/2010	0.04	0.44	1.01	0.01	0.02	0.00	24.47	25.99	1.06	24.51
EZ-SD-WD-17-2	12/4/2010	0.52	2.05	4.34	0.01	0.24	0.00	168.25	175.40	0.05	3307.76
EZ-SD-WD-20-2	12/7/2010	0.10	1.57	3.96	0.01	0.12	0.00	110.13	115.88	4.37	26.54
EZ-SD-WD-21-2	12/7/2010	0.04	0.61	0.87	0.01	0.11	0.00	52.00	53.64	0.87	61.42

TABLE 3-3

Surface Water—Comparison of SRI to Historic Data—Eastern Drainage

Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration	Sample ID of Maximum Detected Concentration	Historic Maximum Detected Concentration	Frequency of Exceedance	Ratio of Current to Historic Maximum Detected Concentration[a]	Maximum Concentration Exceeds Previous Maximum Detected Concentration?
Total Metals (µg/L)[b]								
Arsenic	10.0 - 10.0	0 / 8	--	--	2.20	-- / --	4.55	YES
Cadmium	5.00 - 5.00	5 / 8	8.20	EZ-SD-ED-26-1	230	0 / 8	0.036	NO
Copper	25.0 - 25.0	1 / 8	4.00	EZ-SD-ED-13-1	4.90	0 / 8	0.82	NO
Lead	10.0 - 10.0	1 / 8	26.3	EZ-SD-ED-26-1	5.20	1 / 8	5.06	YES
Manganese	15.0 - 15.0	5 / 8	1,130	EZ-SD-ED-16-1	620	2 / 8	1.82	YES
Zinc	-- - --	8 / 8	4,850	EZ-SD-ED-26-1	26,000	0 / 8	0.19	NO

[a] Shaded cells indicate ratio based on reporting limits

[b] Only total concentrations were compared; dissolved metals concentrations were not available for historic data

TABLE 3-4

Surface Water—Comparison of SRI to Historic Data—Western Drainage

Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration Detected	Sample ID of Maximum Detected Concentration	Historic Maximum Detected Concentration	Frequency of Exceedance	Ratio of Current to Historic Maximum Detected Concentration[a]	Maximum Concentration Exceeds Previous Maximum Detected Concentration?
Total Metals (µg/L)[b]								
Arsenic	10.0 - 10.0	0 / 12	--	--	2.20	-- / --	4.55	YES
Cadmium	-- - --	12 / 12	117	EZ-SD-WD-22-1	230	0 / 12	0.51	NO
Copper	25.0 - 25.0	10 / 12	33.0	EZ-SD-WD-23-1	4.90	5 / 12	6.73	YES
Lead	10.0 - 10.0	8 / 12	40.1	EZ-SD-WD-10-1	5.20	5 / 12	7.71	YES
Manganese	-- - --	12 / 12	533	EZ-SD-WD-22-1	620	0 / 12	0.86	NO
Zinc	-- - --	12 / 12	8,660	EZ-SD-WD-10-1	26,000	0 / 12	0.33	NO

[a] Shaded cells indicate ratio based on reporting limits

[b] Only total concentrations were compared; dissolved metals concentrations were not available for historic data

TABLE 3-5

Sediment—Comparison of SRI to Historic Data—Eastern Drainage

Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration	Sample ID of Maximum Detected Concentration	Historic Maximum Detected Concentration	Frequency of Exceedance	Ratio of Current to Historic Maximum Detected Concentration	Maximum Concentration Exceeds Previous Maximum Detected Concentration?
Metals (mg/kg)								
Arsenic	-- - --	9 / 9	14.7	EZ-SD-ED-26-2	25.0	0 / 9	0.59	NO
Cadmium	0.55 - 0.55	8 / 9	57.8	EZ-SD-ED-25-2	550	0 / 9	0.11	NO
Copper	-- - --	9 / 9	1,090	EZ-SD-ED-26-2	320	1 / 9	3.41	YES
Lead	-- - --	9 / 9	917	EZ-SD-ED-26-2	2,700	0 / 9	0.34	NO
Manganese	-- - --	9 / 9	937	EZ-SD-ED-26-2	750	1 / 9	1.25	YES
Zinc	-- - --	9 / 9	276,000	EZ-SD-ED-26-2	23,000	2 / 9	12.0	YES

TABLE 3-6
Sediment—Comparison of SRI to Historic Data—Western Drainage
Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration	Sample ID of Maximum Detected Concentration	Historic Maximum Detected Concentration	Frequency of Exceedance	Ratio of Current to Historic Maximum Detected Concentration	Maximum Concentration Exceeds Previous Maximum Detected Concentration?
Metals (mg/kg)								
Arsenic	-- - --	8 / 8	17.0	EZ-SD-WD-08-2	25.0	0 / 8	0.68	NO
Cadmium	-- - --	8 / 8	34.7	EZ-SD-WD-17-2	550	0 / 8	0.063	NO
Copper	-- - --	8 / 8	186	EZ-SD-WD-20-2	320	0 / 8	0.58	NO
Lead	-- - --	8 / 8	1,070	EZ-SD-WD-17-2	2,700	0 / 8	0.40	NO
Manganese	-- - --	8 / 8	1,530	EZ-SD-WD-08-2	750	1 / 8	2.04	YES
Zinc	-- - --	8 / 8	9,970	EZ-SD-WD-17-2	23,000	0 / 8	0.43	NO

TABLE 3-7
Surface Soil—Comparison of SRI to Historic Data
Eagle Zinc Company Site, Hillsboro, Illinois

Analyte Name	Range of Non-Detect Values	Frequency of Detection	Maximum Detected Concentration	Sample ID of Maximum Detected Concentration	Historic Maximum Detected Concentration	Frequency of Exceedance	Ratio of Current to Historic Maximum Detected Concentration	Maximum Concentration Exceeds Previous Maximum Detected Concentration?
Inorganics (mg/kg)								
Arsenic	-- - --	19 / 19	17.8	EZ-SS03-1	21.0	0 / 19	0.85	NO
Cadmium	-- - --	20 / 20	9.20	EZ-SS11-1	87.0	0 / 20	0.11	NO
Copper	-- - --	20 / 20	607	EZ-SS11-1	180	1 / 20	3.37	YES
Lead	-- - --	13 / 13	594	EZ-SS11-1	1,100	7 / 13	0.54	NO
Manganese	-- - --	20 / 20	2,490	EZ-SB02-1	1,900	2 / 20	1.31	YES
Zinc	-- - --	20 / 20	26,400	EZ-SS11-1	11,000	2 / 20	2.40	YES

TABLE 3-8

Summary of Comparison of SRI to ESL and Historic Data

Eagle Zinc Company Site, Hillsboro, Illinois

	Surface Water[a]				Sediment[a]						
	Eastern Drainage		Western Drainage		Eastern Drainage		Western Drainage		Soil[a]		Residue
Analyte Name	HQ>1	HDQ>1	HQ>1	HDQ>1	HQ>1	HDQ>1	HQ>1	HDQ>1	HQ>1	HDQ>1	HQ>1
Metals											
Arsenic	NO	YES	NO	YES	YES	NO	YES	NO	NO	NO	**YES**
Cadmium	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	**YES**
Copper	YES	NO	YES	YES	YES	YES	YES	NO	YES	YES	**YES**
Lead	YES	YES	YES	YES	YES	NO	YES	NO	YES	NO	**YES**
Manganese	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	**YES**
Zinc	YES	NO	YES	NO	YES	YES	YES	NO	YES	YES	**YES**
Dissolved Metals											
Arsenic	NO		NO								
Cadmium	YES		YES								
Copper	YES		YES								
Lead	YES		YES								
Manganese	YES		YES								
Zinc	YES		YES								

HQ - Hazard Quotient - Ratio of SRI maximum detected concentration to ESL

HDQ - Historic Detection Quotient - Ratio of SRI maximum detected concentration to historic maximum detected concentration

[a] Shading indicates that *both* the hazard quotient (HQ) and ratio of SRI maximum detected concentration to historic maximum detected concentration (HDQ) are greater than one for that chemical within a drainage.